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RESEARCH

Law enforcement duties and sudden cardiac death among police officers in United States: case distribution study

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Abstract

Objective To assess the association between risk of sudden cardiac death and stressful law enforcement duties compared with routine/non-emergency duties.

Design Case distribution study (case series with survey information on referent exposures).

Setting United States law enforcement.

Participants Summaries of deaths of over 4500 US police officers provided by the National Law Enforcement Officers Memorial Fund and the Officer Down Memorial Page from 1984 to 2010.

Main outcome measures Observed and expected sudden cardiac death counts and relative risks for sudden cardiac death events during specific strenuous duties versus routine/non-emergency activities. Independent estimates of the proportion of time that police officers spend across various law enforcement duties obtained from surveys of police chiefs and front line officers. Impact of varying exposure assessments, covariates, and missing cases in sensitivity and stability analyses.

Results 441 sudden cardiac deaths were observed during the study period. Sudden cardiac death was associated with restraints/altercations (25%, n=108), physical training (20%, n=88), pursuits of suspects (12%, n=53), medical/rescue operations (8%, n=34), routine duties (23%, n=101), and other activities (11%, n=57). Compared with routine/non-emergency activities, the risk of sudden cardiac death was 34-69 times higher during restraints/altercations, 32-51 times higher during pursuits, 20-23 times higher during physical training, and 6-9 times higher during medical/rescue operations. Results were robust to all sensitivity and stability analyses.

Conclusions Stressful law enforcement duties are associated with a risk of sudden cardiac death that is markedly higher than the risk during routine/non-emergency duties. Restraints/altercations and pursuits are associated with the greatest risk. Our findings have public health implications and suggest that primary and secondary cardiovascular prevention efforts are needed among law enforcement officers.

Introduction

Law enforcement is a dangerous occupation. In 2011-12, the fatality rate among patrol officers in the United States was 15-16 per 100 000 full time workers, about 3-5 times the national average for private sector employees.[1 2] Most of these on duty fatalities are traumatic.[2] Statistics for deaths of police on duty that are attributable to cardiovascular disease events are not well documented but are estimated to account for 7% of fatalities.[3] Cardiovascular events among police officers on duty are perceived with increasing concern by the law enforcement community and the general public.[4] Though cardiovascular disease among police has received a high priority from the National Occupational Research Agenda of the National Institute for Occupational Health and Safety,[5] it has not been adequately studied.

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Extra material supplied by the author (see http://www.bmj.com/content/349/bmj.g6534?tab=related#datasupp)

Appendix 1: Supplementary methods
Appendix 2: Supplementary tables A-C
Appendix 3: Supplementary figures A and B

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Some evidence suggests that cardiovascular morbidity is greater among police than the general population; and some jurisdictions provide benefits to police officers or their families after cardiovascular events.[3 6] Studies of "triggering" in the general population show that acute exposure to physical or psychological stress is associated with a short term increase in the risk of acute cardiovascular events, including sudden cardiac death.[7-9] Chronic exposure to established risk factors for cardiovascular disease (such as hypertension, dyslipidemia, obesity, and tobacco smoking) can lead to underlying coronary heart disease or cardiomegaly, providing the pathophysiologic substrate for acute sympathetic arousal and cardiovascular strain to precipitate acute cardiovascular events, including sudden cardiac death.[10] It is thought that stress triggers the final steps in a pathophysiologic cascade, culminating in an acute cardiovascular event.

Evidence indicates that the prevalence of traditional risk factors for cardiovascular disease among the police is high (often higher than the general population).[3] Moreover, law enforcement work involves various acute physical and psychological stressors.[6-13] It is therefore plausible that certain law enforcement tasks could serve as an occupational trigger in susceptible police officers, leading to an increased frequency of sudden cardiac death during stressful duties. This association is indirectly supported by epidemiologic studies of firefighters that have documented a markedly increased risk of acute death from heart disease (10-fold to over 100-fold) during fire suppression compared with non-emergency duties.[14-17] On the basis of studies of triggering and surveys of police officers and chiefs regarding job stress,[13] we hypothesized that stressful law enforcement duties are likely to be associated with increased risk of sudden cardiac death while on duty compared with routine/non-emergency duties.

Methods

We conducted a case-distribution study[18] by combining a case series of sudden cardiac death events among police officers with survey information on the proportion of time on duty that officers spend on different activities. We provide additional information on study design in appendix 1.

Deaths among law enforcement officers

The National Law Enforcement Officers Memorial Fund tracks US police deaths in the line of duty. It is the only major database to systematically consider fatalities arising from medical conditions, such as cardiovascular disease, and consistently documents a larger number of annual fatalities than other databases.[2] This was the primary database we selected for the current study.[19] Because it uses similar inclusion criteria, we also reviewed the Officer Down Memorial Page to identify additional cases of sudden cardiac death.[20]

Both databases define "law enforcement officers" as persons with arrest powers employed by a US law enforcement agency and "death in the line of duty" as a fatality occurring "as a direct and proximate result of a personal injury sustained in the line of duty."[19 20] Regarding on duty deaths from "natural causes," both databases require the medical condition to have arisen out of physical exertion or a specific stressful activity while on duty. Cases deemed related to alcohol, drug, or other substance abuse or intoxication are not included in either database.

Because our goal was to identify sudden cardiac deaths among US police occurring during law enforcement activities independent of their association with specific tasks, we obtained and reviewed an additional database from the National Law Enforcement Officers Memorial Fund with all deaths related to cardiovascular disease among law enforcement officers during the study period that had been submitted for possible inclusion but were ultimately rejected by the fund's board.

Ethical approval

The use of publicly available fatalities databases is exempt from institutional review board evaluation under US law ("deceased, non-living subjects").[21]

Ascertainment of on duty sudden cardiac death events

We selected for further evaluation all non-traumatic fatalities from the two databases and all deaths related to cardiovascular disease but rejected for inclusion in the memorial fund (fig 1⇓). Cases were reviewed to determine eligibility and to extract data. A physician (VV) identified all deaths explicitly labeled as related to cardiovascular disease and selected additional cases consistent with on duty sudden cardiac death. Two additional reviewers (AF, MK) independently assessed the accuracy of the selected cases and re-examined the remaining non-traumatic fatalities for further case inclusions. A board certified occupational physician (SNK) resolved any discrepancies about classifications of cause of death.

We extracted the following information for each fatality: age, sex, date of death, listed cause of death, and the narrative case summary. Case summaries provide a short description for each law enforcement officer fatality; these were reviewed for possible inclusion as sudden cardiac death cases following established procedures.[15-23]

We selected for analysis only those cases determined to be sudden cardiac deaths on duty. We defined sudden cardiac death as a fatality characterized by a sudden loss of consciousness (within one hour of the onset of acute symptoms, if present) in the absence of other compatible explanations (such as cerebrovascular event, pulmonary embolism, aortic aneurysm, etc).[22 24] We excluded deaths that occurred more than 24 hours after the on duty event unless the law enforcement officer had sudden loss of consciousness while on duty and then never regained it before a later biologic death (for example, cardiac arrest followed by a period of maintenance on life support without the patient regaining consciousness).

Police duties at the time of the death

Based on each sudden cardiac death case summary, we classified deaths according to the specific duty being performed at onset of symptoms or immediately preceding death. Duties were categorized as routine/non-emergency or non-routine/stressful based on independent national surveys of police stress in relation to a wide spectrum of different law enforcement duties.[13] "Routine/non-emergency duties" included the following activities: attending meetings; classroom activities; desk duty, office, and paperwork; escorting (such as funerals, dignitaries); firing range practice; investigation/inspection; issuing parking/traffic tickets; and patrol and roll call. "Non-routine duties" were defined as "disturbance" (domestic disturbance calls and disturbance of peace calls); medical and rescue operations; physical training (on duty exercise, physical training or drills related to employment, and law enforcement fitness tests); physical restraints/physical altercations (with suspects, prisoners, other detainees, or other uncooperative members of the public, etc); serving a warrant; suspect pursuits; testifying in court; and transporting/supervising prisoners.[13]

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Time spent on specific duties

We estimated the proportion of time spent across different law enforcement duties from national surveys of frontline police officers and police chiefs.[13] The first set of estimates was based on data from 951 frontline officers contacted through the International Union of Police Associations and the Fraternal Order of Police (response rate not available). The second set of estimates was based on data from 93 police chiefs (27% response rate) who completed the survey based on the experience of typical patrol officers in their respective departments. The two surveys provided similar patterns of the proportion of time on duty spent on different activities. We also obtained information on officer age, location of police department (rural, suburban, or urban), jurisdiction size (based on covered population), and size of police department (based on number of officers).

Statistical analysis

If the duties performed were unrelated to the risk of sudden cardiac death, the number of deaths associated with each duty would be proportional to the time officers spend performing that duty. For example, if police officers spend 75% of their time on routine/non-emergency duties, we would expect 75% of sudden cardiac deaths to be associated with such duties. Thus, using survey results and the total number of sudden cardiac death events, we derived the expected number of sudden cardiac death events associated with each duty and calculated ratios of observed to expected (O:E) events. We then estimated duty specific relative risks for sudden cardiac death and corresponding 95% confidence intervals by fitting a Poisson regression model with the observed count of sudden cardiac deaths as the response and the logarithm of the proportion of time per duty as the offset.

We conducted stability analyses using different exposure estimates of the proportional time spent across law enforcement duties. These included stratification of the officer and chief surveys based on jurisdiction size and use of only the survey responses of frontline law enforcement officers with a similar age distribution as the cases.

We estimated the age specific incidence rate of sudden cardiac death per 100 000 person years at risk. Assuming an average of 2080 worked hours a year,[25] we obtained person time estimates based on the number of law enforcement officers at risk according to the Current Population Survey (1989-2010)[26] and the proportion of on duty time spent in each duty.

Additionally, to evaluate robustness[27] to potentially unreported cases of sudden cardiac death during routine/non-emergency duties, we repeated our analyses after hypothetically assuming a number of missing sudden cardiac deaths ranging from 0 (that is, equivalent to our main analysis) to 1000 (that is, more than twice the observed total number of events). We also repeated our analyses after hypothetically assuming that a proportion of time considered as routine/non-emergency activities ranging from 0% (that is, equivalent to our main analysis) to 20% (that is, a fifth of on duty time) should have been classified as a specific strenuous duty.

We performed all statistical analyses using Stata 13.1/SE (StataCorp, College Station, TX). $P<0.05$ was considered to indicate significance, and all tests were two sided.

Results

The National Law Enforcement Officers Memorial Fund included records for 4553 on duty police fatalities between 1 January 1984 and 31 December 2010 of which we categorized 331 as sudden cardiac deaths. The Officer Down Memorial Page database included records on 4661 deaths during the same period, with 359 classified as sudden cardiac deaths. Overlap between the two databases was high (91% of all unique cases of sudden cardiac death were included in both databases). During the study period the memorial fund rejected 126 events related to cardiovascular disease, of which we categorized 78 as on duty sudden cardiac deaths after review. Thus, we identified at total of 441 unique sudden cardiac deaths (fig 1⇓) or roughly 9-10% of all on duty police fatalities. The mean age at the time of death was 47 years (SD 9 years). Only nine of the cases (2%) were in women.

We were able to identify the duty associated with the sudden cardiac death for 431 of the cases (98%). Sudden cardiac death was most commonly associated with restraints/physical altercations (25%), followed by routine/non-emergency activities (23%), physical training (20%), and pursuits (12%); 19% of events were associated with other duties (table 1⇓).

Table 1⇓ shows the estimated proportion of time spent on each duty, expected events, and ratios of observed to expected events based on the frontline officer and chief surveys. It also summarizes the relative risk estimates for the association of specific duties with sudden cardiac death compared with routine/non-emergency activities. Higher risks of sudden cardiac death (relative risk >10) were observed for restraints and physical altercations, suspect pursuits, and physical training. We also found evidence supporting an association between sudden cardiac death risk and transporting/supervising prisoners, medical and rescue operations, and less consistent evidence for associations with serving a warrant and responding to disturbances.

Figure 2⇓ shows the incidence rates of sudden cardiac death among law enforcement officers by duty and age group. The total and duty specific risk of sudden cardiac death increased with age.

Stability analyses conducted to explore the impact of jurisdiction size (population served; table 2⇓) and age of the officer (table 3⇓ and table C in appendix 2) produced results that were qualitatively similar to the main analyses presented above. Sensitivity analyses showed that our main findings remained robust across hypothetical scenarios varying the number of missing sudden cardiac death reports and the magnitude of misclassification of strenuous duty times (figs A and B in appendix 3). During restraints/physical altercations, suspect pursuits, and physical training, the relative risk point estimates and the lower bound of the 95% confidence interval remained greater than 1.0, supporting a significantly increased risk of sudden cardiac death even under the most extreme hypothetical scenarios.

Discussion

Principal findings

Physically and psychologically stressful law enforcement duties are associated with large increases in the risk of sudden cardiac death compared with routine/non-emergency policing activities. To our knowledge our study is the first to show an association between specific law enforcement duties and risk of sudden cardiac death—a finding that supports the hypothesis that stressful work related activities can "trigger" sudden cardiac death and is consistent with our previous studies of on duty acute cardiac deaths among firefighters.[14-16] In addition, our finding that up to 10% of all on duty deaths during law enforcement are sudden cardiac deaths represents the most

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accurate estimate to date of the proportionate mortality from sudden cardiac death in this population.

While routine/non-emergency duties constituted about 75% of police work time, 77% of sudden cardiac deaths occurred during non-routine tasks. Physical restraints and altercations comprised about 1-2% of a police officer's annual professional time but accounted for 25% of on duty sudden cardiac deaths. Therefore, restraints and altercations were associated with a sudden cardiac death risk about 30-70 times higher than the risk during routine/non-emergency law enforcement duties. Similarly, pursuits of suspects also comprised less than 2% of on duty time but were associated with 12% of sudden cardiac deaths and risks 30-50 times higher than during routine/non-emergency duties. The most likely explanation for these findings is a sudden increase in cardiovascular demand because of a combination of physical exertion and psychological stress, consistent with "fight or flight" physiology.[10 28] These results are also consistent with police chief and frontline officer ratings of altercations and pursuits as the most stressful duties,[13] as well as prior investigations of heart rate monitoring among on duty police officers, documenting pronounced tachycardia during these confrontational situations.[29 30]

Although police do not perceive physical training as particularly stressful,[13] we found that training activities were associated with about 20-25 times higher risk of sudden cardiac death when compared with routine/non-emergency law enforcement duties. These findings are compatible with evidence linking physical exertion to cardiovascular event triggering in the general population, particularly among physically inactive persons,[7-31] as well as findings on the association of physical training with sudden cardiac death in the US fire service.[15]

Medical and rescue operations, supervising and transporting prisoners, and other potentially stressful interactions with the public (such as serving warrants and responding to various civil disturbances) were associated with an increased risk of sudden cardiac death. These findings are important because currently the law enforcement community does not usually consider these duties as strenuous.[19 20] The considerable psychological stress of these activities and their potential to trigger cardiovascular events has implications for related workers' compensation, disability retirement, and death benefit claims.

Applicability of research findings

We believe that our findings are also applicable to law enforcement work outside the US. Law enforcement duties show substantial variation across jurisdictions in the US, rendering our findings more broadly representative. Furthermore, triggering of sudden cardiac death by acute exposure of susceptible individuals to physical or psychological stress is a pathophysiological mechanism shared by other occupations characterized by short bursts of stressful and physically demanding tasks.[3-17] For many law enforcement officers, most on duty time is spent on relatively sedentary activities, punctuated by unpredictable short periods of stressful activities.[28] In addition, officers have a relatively high prevalence of risk factors for cardiovascular disease, such as hypertension, obesity, dyslipidemia, and subclinical atherosclerosis.[3 6] In the general population, bursts of physical exertion or emotional stress have been associated with myocardial infarction and sudden cardiac death, particularly among individuals with low physical fitness and underlying cardiovascular disease.[7-32] It seems that similar mechanisms are operating during strenuous duties in susceptible officers with underlying disease.

Study limitations

Our work has some limitations. First, there are no large scale studies of how US law enforcement officers in different locations spend their time. We used nationwide survey data from police chiefs and front line officers, and we were able to account for variation in officer rank, size of population served, and department location when estimating the proportion of time officers spent on various duties.[13]

Second, no single database catalogues all on duty law enforcement fatalities related to cardiovascular disease, and databases that do track such cases selectively include events that occur during stressful situations. We were, however, able to obtain all cases related to cardiovascular disease denied by the National Law Enforcement Officers Memorial Fund after submission for consideration. There is good reason to believe that most cases of sudden cardiac death in police officers would be submitted for consideration based on the desire to honor the dead officers and to establish eligibility for financial benefits available to officers' families after on duty deaths from cardiovascular disease.[3 6] This is supported by the fact that we had to exclude numerous submitted cases in which the cardiovascular event obviously occurred while off duty. Furthermore, sensitivity analyses showed that the association of most duties with sudden cardiac death would persist, unless the number of missing cases was implausibly large. Therefore, missing event reports are unlikely to account for our results.

Third, to identify cases of sudden cardiac death and the associated duties, we relied on information abstracted from brief summaries without prior medical records and often lacked corroboration by autopsy results. Therefore, we used only those cases verified by multiple independent reviewers and limited our analyses to cases for which the cause of death could be ascertained with certainty. We have recently shown high agreement between identification of sudden cardiac death through brief case histories from public safety databases and comprehensive investigative reports conducted by health personnel contracted by the US National Institute for Occupational Safety and Health.[33] Furthermore, with respect to time spent on different duties, sensitivity analyses showed that for most emergency duties, exposure misclassification would have to be extreme to explain away our findings.

Fourth, we could not assess the contribution of risk factors for cardiovascular disease (such as obesity, hypertension, and diabetes) to the sudden cardiac death events because data were not available in the case summaries we reviewed. Existing evidence, however, supports that "triggering" occurs almost exclusively on a substrate of underlying disease.[6-23] The case summaries also did not include information on the time of death; therefore, we could not assess the impact of work shift on risk of sudden cardiac death.

Implications for future research and policy

The limitations of our study reflect the fact that, at present, the "best available data" are imperfect. Our results are best interpreted as indicative of the direction and relative magnitude of the associations between stressful police duties and sudden cardiac death, rather than an exact quantification of the magnitude of these associations. That said, the consistency of our results across stability and sensitivity analyses suggests that these associations are valid and merit further study. Future research could obtain officer level information on daily activities, use data from medical records and autopsies to identify cardiac deaths, and implement self controlled study

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designs to more accurately quantify the association between stressful policing activities and sudden cardiac death.

Our findings have public health implications for prevention of cardiovascular disease among law enforcement officers and call for the implementation of prevention efforts for primary and secondary cardiovascular disease. Management of risk factors for cardiovascular disease—including interventions to increase physical activity, promote smoking cessation, maintain a healthy weight, and treat hypertension and dyslipidemia—could be used to protect police officers from the triggering effects of stressful duties and also reduce rates of long term cardiovascular disease. Our results support the US National Institute for Occupational Safety and Health research agenda that prioritizes research on cardiovascular disease among law enforcement officers, similar to efforts in firefighters.[5]

Conclusions

Using nationwide data on sudden cardiac death in law enforcement officers on duty and survey data on the proportion of time spent on specific duties, we found that stressful and physically demanding law enforcement activities were associated with large increases in the risk of sudden cardiac death, compared with routine/non-emergency policing activities.

We thank the National Law Enforcement Officers Memorial Fund and Officer Down Memorial Page for providing information on police officer deaths. We thank William J Johnson (National Association of Police Organizations), Stephen Fender, George Sherrill, Kevin Summers (Fraternal Order of Police), Sam Cabral, and the International Union of Police Associations for supporting surveys of time spent on law enforcement duties. We also thank Byron Wallace (University of Texas at Austin) for providing help with data abstraction and coding. We express our deepest appreciation to the police chiefs, police departments, and frontline police officers for their collaboration with the surveys and their service to the public.

Contributors: VV contributed to the design of the study, acquisition of data, interpretation of data, and drafting the manuscript. AF contributed to the analysis and interpretation of data. MK contributed to the analysis and interpretation of data, and drafting the manuscript. SS contributed to the design of the study and acquisition of data. IJD contributed to the design of the study, acquisition of data, analysis and interpretation of data, and drafting the manuscript. SNK conceived the idea and the design of the study, contributed to obtaining funding, acquisition of data, analysis and interpretation of data, and drafting the manuscript. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. All authors revised the manuscript critically for important intellectual content. SNK is guarantor.

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Competing interests: All authors have completed the ICMJE uniform disclosure form and declare that SNK served as paid expert witness, independent medical examiner, or both, in workers' compensation and disability cases, including cases involving law enforcement.

Ethical approval: Not required.

Data sharing: The data on police officer deaths and case histories are available online. Statistical code is available from the corresponding author.

Transparency declaration: The corresponding author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; no important aspects of the study have been omitted; and any discrepancies from the study as planned have been explained.

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What is already known on this topic

Epidemiologic studies in fire fighters suggest that the risk of sudden cardiac death is increased during stressful duties compared with non-emergency duties

Data about the impact of specific on duty activities on cardiovascular deaths among police officers are not available

What this study adds

Among US police officers, stressful duties were associated with large increases in the risk of sudden cardiac death compared with routine/non-emergency policing activities

Restraints and altercations were associated with about 30-70 times the risk of sudden cardiac death compared with routine/non-emergency law enforcement duties

Training activities were associated with about 20-25 times the risk of sudden cardiac death compared with routine/non-emergency law enforcement duties

Tables

Table 1| Risk of sudden cardiac death among law enforcement officers engaged in emergency and strenuous duties compared with officers engaged in routine/non-emergency duties. Combined data from National Law Enforcement Officers Memorial Fund and Officer Down Memorial Page (1984-2010)*

		Frontline police officers survey				Police chiefs survey			
Duty	Observed events (%)	% time per duty†	Expected events	O:E	Relative risk (95% CI)	% time per duty†	Expected events	O:E	Relative risk (95% CI)
Routine/non-emergency	101 (23.4)	77.4	333.6	0.30	Reference	72.8	313.8	0.32	Reference
Disturbance	20 (4.6)	9.6	41.4	0.48	1.60 (0.99 to 2.58)	8.8	37.9	0.53	1.64 (1.01 to 2.65)
Testifying in court	3 (0.7)	1.4	6.0	0.50	1.64 (0.52 to 5.18)	1.3	5.6	0.54	1.66 (0.53 to 5.24)
Serving warrant	6 (1.4)	1.6	6.9	0.87	2.87 (1.26 to 6.55)	2.4	10.3	0.58	1.80 (0.79 to 4.11)
Transporting or supervising prisoners	18 (4.2)	2.2	9.5	1.90	6.27 (3.80 to 10.4)	4.1	17.7	1.02	3.16 (1.92 to 5.22)
Medical and rescue operations	34 (7.9)	2.9	12.5	2.72	8.98 (6.09 to 13.3)	3.9	16.8	2.02	6.28 (4.26 to 9.27)
Physical training	88 (20.4)	2.9	12.5	7.04	23.3 (17.5 to 30.9)	3.1	13.4	6.59	20.5 (15.4 to 27.2)
Pursuit	53 (12.3)	0.8	3.5	15.4	50.8 (36.4 to 70.8)	1.2	5.2	10.2	31.8 (22.8 to 44.4)
Restraint, physical altercation	108 (25.1)	1.2	5.2	20.9	69.0 (52.6 to 90.5)	2.3	9.9	10.9	33.8 (25.8 to 44.4)

O/E=observed over expected number of events.

*Results ordered by magnitude of estimated relative risk based on frontline police officers survey.

†Based on data from Korre et al[13]; see table A in appendix 2.

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Table 2| **Analyses of risk of sudden cardiac death among law enforcement officers engaged in emergency and strenuous duties compared with officers engaged in routine/non-emergency duties, combined data from National Law Enforcement Officers Memorial Fund and Officer Down Memorial Page (1984-2010), stratified by size of population served by officers' department. Figures are relative risk (95% confidence interval)***

	Population served		
Duty*	**<10 000**	**10 001-100 000**	**>100 000**
Routine /non-emergency	1.00 (reference)	1.00 (reference)	1.00 (reference)
Physical training	7.80 (2.22 to 27.4)	28.9 (13.6 to 61.4)	18.3 (9.44 to 35.5)
Pursuit	46.8 (22.3 to 98.3)	79.7 (33.0 to 192.3)	52.9 (26.5 to 105.6)
Restraint, physical altercation	187.2 (93.7 to 373.8)	119.5 (59.5 to 240.3)	51.9 (27.4 to 98.3)

*Estimates based on survey responses from officers whose departments serve populations of indicated size.

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Table 3| **Analyses of risk of sudden cardiac death among law enforcement officers engaged in emergency and strenuous duties compared with officers engaged in routine/non-emergency duties, using combined data from National Law Enforcement Officers Memorial Fund and Officer Down Memorial Page (1984-2010). Sensitivity analyses restricted to survey responses from law enforcement officers with similar age distribution (individual matching based on 5 year age classes) as cases of sudden cardiac death**

Duty	Relative risk (95% CI)
Routine/non-emergency	1.00 (reference)
Disturbance	1.64 (1.00 to 2.68)
Testifying in court	1.63 (0.52 to 5.13)
Serving a warrant	2.17 (0.95 to 4.94)
Transporting and supervising prisoners	3.79 (2.27 to 6.35)
Medical and rescue operations	7.36 (4.97 to 10.9)
Physical training	27.8 (20.9 to 37.1)
Pursuit	25.8 (18.4 to 36.2)
Restraint, physical altercation	40.6 (30.9 to 53.3)

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Figures

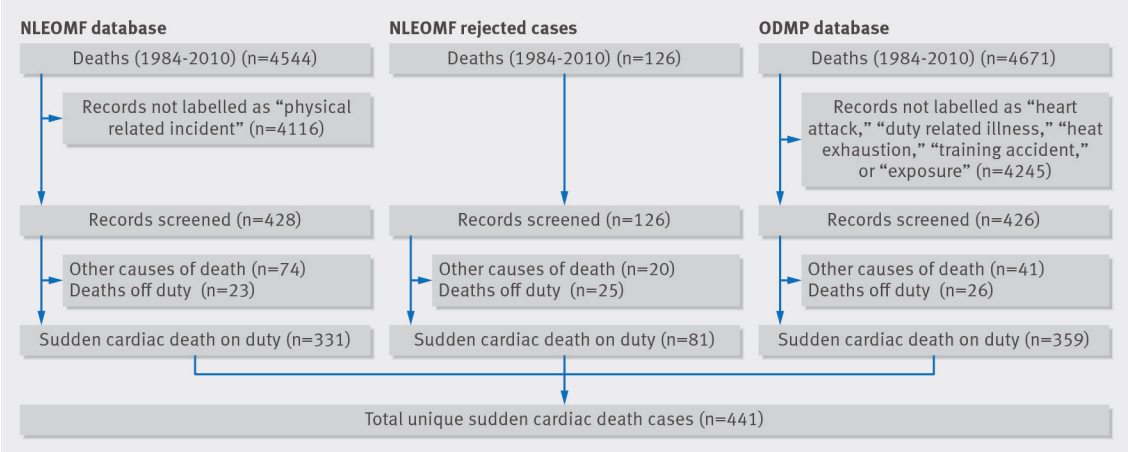

Fig 1 Review of police fatality databases and selection of cases of sudden cardiac death leading to final study population

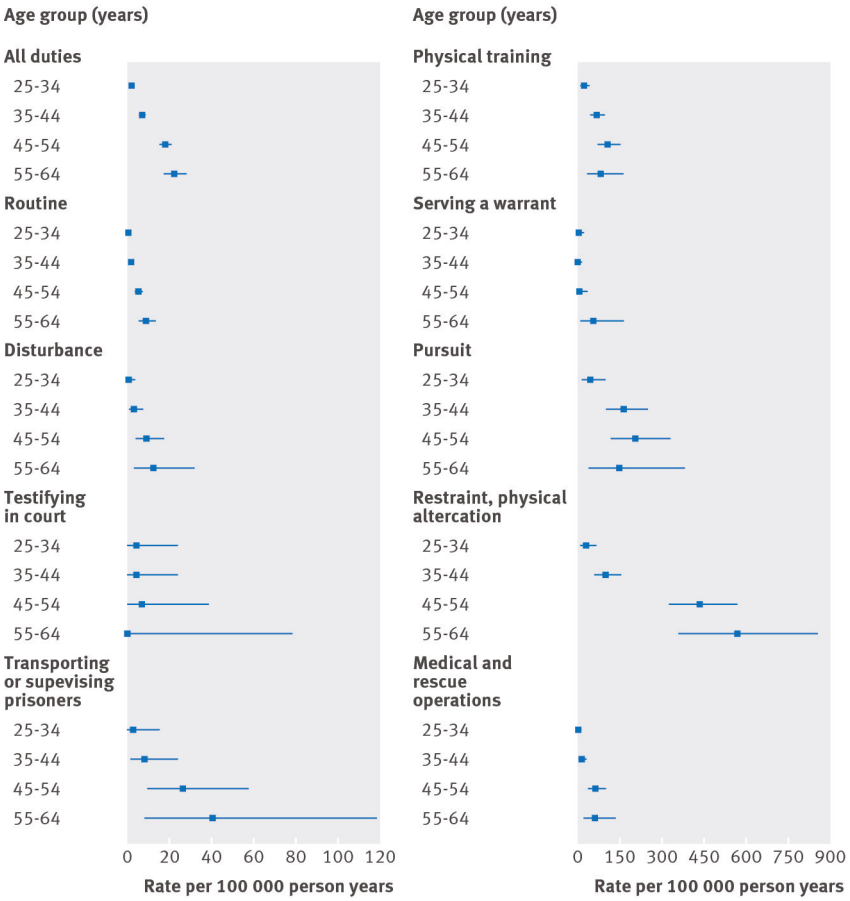

Fig 2 Incidence rates of sudden cardiac death among male law enforcement officers (1989-2010), by age and type of duty

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